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3406C
INDUSTRIAL ENGINES
Maintenance Intervals

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CATERPILLAR

i01369886

Maintenance Interval Schedule

SMCS Code: 1000; 7500

Before performing any operation or maintenance procedures, ensure that the Safety Information, warnings, and instructions are read and understood.

To determine the maintenance intervals, use fuel consumption, service hours, or calendar time, which ever occurs first.

Before each consecutive interval is performed, all of the maintenance requirements from the previous interval must be performed.

When Required

Battery - Replace 63
Battery or Battery Cable - Disconnect 64
Engine - Clean 72
Engine Air Cleaner Element (Single Element) - Inspect/Replace 72
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Daily

Air Starting Motor Lubricator Oil Level - Check 61
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Every Week

Battery Charger - Check 64

Every 1000 Service Hours

Engine Protective Devices - Check 77
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Every 9500 L (2500 US gal) of Fuel or 250 Service Hours or Yearly

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Battery Electrolyte Level - Check 63
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Every 114 000 L (30 000 US gal) of Fuel or 3000 Service Hours or 2 Years

Cooling System Coolant (DEAC) - Change 65
Cooling System Coolant Extender (ELC) - Add 68
Cooling System Water Temperature Regulator - Replace 70
Crankshaft Vibration Damper - Inspect 71
Engine Mounts - Inspect 74
Engine Valve Lash - Inspect/Adjust 77
Engine Valve Rotators - Inspect 77
Fuel Ratio Control - Inspect/Adjust 79
Turbocharger - Inspect 87

Every 190 000 L (50 000 US gal) of Fuel or 5000 Service Hours

Air Compressor - Inspect 60
Alternator - Inspect 62
Fuel Injection Nozzles - Test/Exchange 78
Starting Motor - Inspect 87
Water Pump - Inspect 89

Every 228 000 L (60 000 US gal) of Fuel or 6000 Service Hours or 6 Years

Cooling System Coolant (ELC) - Change 67

Every 380 000 L (100 000 US gal) of Fuel or 10 000 Service Hours

Overhaul Considerations 83

i01371758

Aftercooler Core - Clean/Test (Air-To-Air Aftercooler)

SMCS Code: 1064-070; 1064-081

Note: Adjust the frequency of cleaning according to the effects of the operating environment.

Inspect the aftercooler for these items: damaged fins, corrosion, dirt, grease, insects, leaves, oil, and other debris. Clean the aftercooler, if necessary.

For air-to-air aftercoolers, use the same methods that are used for cleaning radiators.

⚠ WARNING

Personal injury can result from air pressure.

Personal injury can result without following proper procedure. When using pressure air, wear a protective face shield and protective clothing.

Maximum air pressure at the nozzle must be less than 205 kPa (30 psi) for cleaning purposes.

Pressurized air is the preferred method for removing loose debris. Direct the air in the opposite direction of the fan's air flow. Hold the nozzle approximately 6 mm (0.25 inch) away from the fins. Slowly move the air nozzle in a direction that is parallel with the tubes. This will remove debris that is between the tubes.

Pressurized water may also be used for cleaning. The maximum water pressure for cleaning purposes must be less than 275 kPa (40 psi). Use pressurized water in order to soften mud. Clean the core from both sides.

Use a degreaser and steam for removal of oil and grease. Clean both sides of the core. Wash the core with detergent and hot water. Thoroughly rinse the core with clean water.

After cleaning, start the engine and accelerate the engine to high idle rpm. This will help in the removal of debris and drying of the core. Stop the engine. Use a light bulb behind the core in order to inspect the core for cleanliness. Repeat the cleaning, if necessary.

Inspect the fins for damage. Bent fins may be opened with a "comb".

Note: If parts of the aftercooler system are repaired or replaced, a leak test is highly recommended.

Inspect these items for good condition: welds, mounting brackets, air lines, connections, clamps, and seals. Make repairs, if necessary.

For more detailed information on cleaning and inspection, see Special Publication, SEBD0518, "Know Your Cooling System".

i01183385

Air Compressor - Inspect

SMCS Code: 1803-040

⚠ WARNING

Do not disconnect the air line from the air compressor governor without purging the air brake and the auxiliary air systems. Failure to purge the air brake and the auxiliary air systems before removing the air compressor and/or the air lines could cause personal injury.

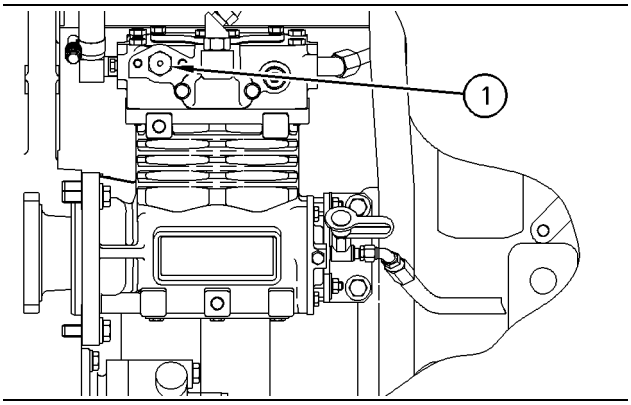


Illustration 29 g00633741

(1) Air compressor pressure relief valve

⚠ WARNING

If the air compressor pressure relief valve that is mounted in the air compressor cylinder head is bypassing compressed air, there is a malfunction in the air system, possibly ice blockage. Under these conditions, your engine may have insufficient air for normal brake operation.

Do not operate the engine until the reason for the air bypass is identified and corrected. Failure to heed this warning could lead to property damage, personal injury, or death to the operator or bystanders.

The function of the air compressor pressure relief valve is to bypass air when there is a malfunction in the air compressor system.

The air compressor pressure relief valve releases air at 1723 kPa (250 psi). It is very important that all personnel stand clear of the air compressor pressure relief valve when compressed air is released. All personnel should also stay clear of the air compressor when the engine is operating and the air compressor is exposed.

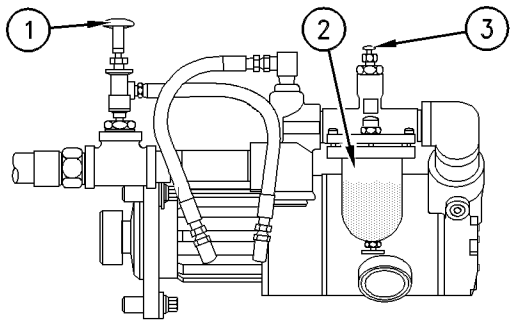
Refer to the Service Manual or refer to the OEM specifications in order to find information concerning the air compressor. Consult your Caterpillar dealer for assistance.

i00805129

Air Starting Motor Lubricator Oil Level - Check (If Equipped)

SMCS Code: 1451-535

NOTICE
Never allow the lubricator bowl to become empty. The air starting motor will be damaged by a lack of lubrication. Ensure that sufficient oil is in the lubricator bowl.



g00381232

Illustration 30

(1) Air valve
(2) Lubricator bowl
(3) Adjustment knob

1. The vanes of the air starting motor are lubricated with a fine mist of oil from the air starting motor lubricator. Check the level of oil in lubricator bowl (2). If the oil level is less than 1/2, add oil to the lubricator bowl.

2. Ensure that the air supply to the lubricator is OFF.

3. Remove the plug. Pour oil into lubricator bowl (2). Use “10W” oil for temperatures that are greater than 0° C (32° F). Use air tool oil for temperatures that are below 0° C (32° F).

4. Install the plug.

Oiler Feed Adjustment

If necessary, adjust the lubricator in order to release approximately two drops of fluid per 30 seconds into the starting motor air stream.

1. Ensure that the fuel supply to the engine is OFF.

2. Turn adjustment knob (3) clockwise until the adjustment knob locks.

3. Turn adjustment knob (3) counterclockwise for 1/4 turns.

NOTICE
Do not crank the engine continuously for more than 30 seconds. Allow the starting motor to cool for two minutes before cranking the engine again.

4. Crank the starting motor for ten seconds and observe the exhaust air from the mufflers of the starting motor. Look for oil mist. A slight oil mist should be barely visible.

If no mist is observed, or if the mist is excessive, rotate adjustment knob (3) in increments of 1/16 in order to increase or decrease the oil mist. Repeat the starting motor cranking and observe until the mist is satisfactory.

Note: Drip rates should only be made under an average steady flow condition. Once a steady flow condition is established, the lubricator will automatically adjust the drip rate in proportion to the variations in air flow.

i00847451

Air Tank Moisture and Sediment - Drain (If Equipped)

SMCS Code: 1466-543-M&S

Moisture and sediment in the air starting system can cause the following conditions:

- Freezing
- Corrosion of internal parts
- Malfunction of the air starting system

⚠ WARNING

When opening the drain valve, wear protective gloves, a protective face shield, protective clothing, and protective shoes. Pressurized air could cause debris to be blown and result in personal injury.

1. Open the drain valve that is on the bottom of the air tank. Allow the moisture and sediment to drain.
2. Close the drain valve.
3. Check the air supply pressure. The air starting motor requires a minimum of 620 kPa (90 psi) of air pressure to operate properly. The maximum air pressure must not exceed 1550 kPa (225 psi). The normal air pressure will be 758 to 965 kPa (110 to 140 psi).

i00072207

Alternator - Inspect

SMCS Code: 1405-040

Caterpillar recommends a scheduled inspection of the alternator. Inspect the alternator for loose connections and proper battery charging. Inspect the ammeter (if equipped) during engine operation in order to ensure proper battery performance and/or proper performance of the electrical system. Make repairs, as required. Refer to the Service Manual.

Check the alternator and the battery charger for proper operation. If the batteries are properly charged, the ammeter reading should be very near zero. All batteries should be kept charged. The batteries should be kept warm because temperature affects the cranking power. If the battery is too cold, the battery will not crank the engine. The battery will not crank the engine, even if the engine is warm. When the engine is not run for long periods of time or if the engine is run for short periods, the batteries may not fully charge. A battery with a low charge will freeze more easily than a battery with a full charge.

i00165437

Alternator Belt - Inspect/Adjust/Replace

SMCS Code: 1357-036; 1357-510

Inspection

To maximize the engine performance, inspect the belt for wear and for cracking. Check the belt tension. Adjust the belt tension in order to minimize belt slippage. Belt slippage will decrease the life of the belt.

To check the belt tension, apply 110 N (25 lb) of force midway between the pulleys. A correctly adjusted belt will deflect 13 to 19 mm (0.50 to 0.75 inch).

Adjustment

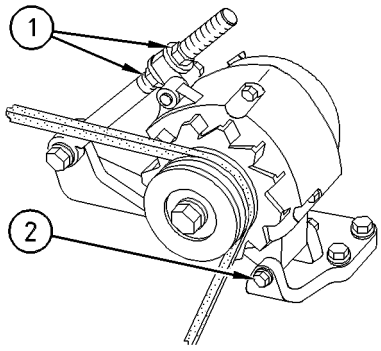


Illustration 31 g00122875

Typical Adjusting Nuts (1) and Mounting Bolt (2)

1. Remove the belt guard.
2. Loosen mounting bolt (2) and adjusting nuts (1).
3. Turn adjusting nuts (1) in order to increase or decrease the belt tension.
4. Tighten adjusting nuts (1). Tighten mounting bolt (2). Refer to the Operation and Maintenance Manual for the proper torques.
5. Reinstall the belt guard.

If new belts are installed, check the belt adjustment again after 30 minutes of engine operation at the rated rpm.

Replacement

For applications that require multiple drive belts, replace the belts in matched sets. Replacing only one belt of a matched set will cause the new belt to carry more load because the older belts are stretched. The additional load on the new belt could cause the new belt to break.

Refer to the Service Manual for more information on the procedures for the following topics: belt removal and belt installation.

i01179608

Battery - Replace

SMCS Code: 1401-510

⚠ WARNING

Batteries give off combustible gases which can explode. A spark can cause the combustible gases to ignite. This can result in severe personal injury or death.

Ensure proper ventilation for batteries that are in an enclosure. Follow the proper procedures in order to help prevent electrical arcs and/or sparks near batteries. Do not smoke when batteries are serviced.

1. Turn the key start switch to the OFF position. Remove the key and all electrical loads.
2. Turn OFF the battery charger. Disconnect the charger.
3. The NEGATIVE "-" cable connects the NEGATIVE "-" battery terminal to the ground plane. Disconnect the cable from the NEGATIVE "-" battery terminal.
4. The POSITIVE "+" cable connects the POSITIVE "+" battery terminal to the starting motor. Disconnect the cable from the POSITIVE "+" battery terminal.

Note: Always recycle a battery. Never discard a battery. Return used batteries to an appropriate recycling facility.

5. Remove the used battery.
6. Install the new battery.

Note: Before the cables are connected, ensure that the key start switch is OFF.

7. Connect the cable from the starting motor to the POSITIVE "+" battery terminal.
8. Connect the cable from the ground plane to the NEGATIVE "-" battery terminal.

i01206348

Battery Electrolyte Level - Check

SMCS Code: 1401-535

When the engine is not run for long periods of time or when the engine is run for short periods, the batteries may not fully recharge. Ensure a full charge in order to help prevent the battery from freezing. If batteries are properly charged, ammeter reading should be very near zero.

⚠ WARNING

All lead-acid batteries contain sulfuric acid which can burn the skin and clothing. Always wear a face shield and protective clothing when working on or near batteries.

1. Remove the filler caps. Maintain the electrolyte level to the "FULL" mark on the battery.

   If the addition of water is necessary, use distilled water. If distilled water is not available use clean water that is low in minerals. Do not use artificially softened water.

2. Check the condition of the electrolyte with the 1U-7298 Coolant/Battery Tester (°C) or the 1U-7297 Coolant/Battery Tester (°F).
3. Keep the batteries clean.

   Clean the battery case with one of the following cleaning solutions:

   - A mixture of 0.1 L (0.11 qt) of baking soda and 1 L (1 qt) of clean water
   - A mixture of 0.1 L (0.11 qt) of ammonia and 1 L (1 qt) of clean water

   Thoroughly rinse the battery case with clean water.

Use a fine grade of sandpaper to clean the terminals and the cable clamps. Clean the items until the surfaces are bright or shiny. DO NOT remove material excessively. Excessive removal of material can cause the clamps to not fit properly. Coat the clamps and the terminals with 5N-5561 Silicone Lubricant, petroleum jelly or MPGM grease.

i00095575

Battery or Battery Cable - Disconnect

SMCS Code: 1402-029

1. Turn the start switch to the OFF position. Turn the ignition switch (if equipped) to the OFF position and remove the key and all electrical loads.
2. Disconnect the negative battery terminal at the battery that goes to the start switch. Ensure that the cable cannot contact the terminal. When four 12 volt batteries are involved, the negative side of two batteries must be disconnected.
3. Tape the leads in order to help prevent accidental starting.
4. Proceed with necessary system repairs. Reverse the steps in order to reconnect all of the cables.

i01039758

Battery Charger - Check

SMCS Code: 1401-535

Checking Before Start-Up

Check the battery charger for proper operation. If the batteries are properly charged, the needle of the ammeter will register near “0” (zero).

The battery charger must not produce excessive current during start-up. Alternatively, the charger must be automatically disconnected for start-up. If the engine has an alternator, the charger must be automatically disconnected during start-up and during engine operation.

Charging the Battery

⚠ WARNING

Never disconnect any charging unit circuit or battery circuit cable from the battery when the charging unit is operated. A spark can cause an explosion from the flammable vapor mixture of hydrogen and oxygen that is released from the electrolyte through the battery outlets. Injury to personnel can be the result.

Perform the following procedure to charge the battery:

1. Ensure that the charger is turned OFF.
2. Adjust the voltage of the charger in order to match the voltage of the battery.
3. Connect the POSITIVE “+” lead of the charger to the POSITIVE “+” battery terminal. Connect the NEGATIVE “-” lead of the charger to the NEGATIVE “-” battery terminal.
4. Turn ON the battery charger.

Overcharging of Batteries

Overcharging reduces the service life of batteries. Use a battery charger that will not overcharge the battery. DO NOT charge the battery if the meter of the battery charger is in the RED zone.

Overcharging is indicated by the following symptoms:

- The battery is very warm to the touch.
- A strong odor of acid is present.
- The battery emits smoke or a dense vapor (gas).

Perform one of the following procedures if the battery shows symptoms of overcharging:

- Reduce the rate of charging by a significant amount. Complete the charging at the reduced rate.
- Turn OFF the charger.

Table 34 describes the effects of overcharging on different types of batteries.

Table 34

Effects of Overcharging Batteries	
Type of Battery	**Effect**
Caterpillar General Service Batteries Caterpillar Premium High Output Batteries	All of the battery cells have a low level of electrolyte.
	When the plates of the battery are inspected through the filler holes, the plates may appear to be warped. This is caused by an excessive temperature.
	The battery may not pass a load test.
Caterpillar Maintenance Free Batteries	The battery may not accept a charging current.
	The battery may not pass a load test.

Checking After Stopping

Ensure that the battery charger is connected properly. Observe the meter of the charger. Record the amperage.

i01206425

Cooling System Coolant (DEAC) - Change

SMCS Code: 1350-070; 1395-044

Clean the cooling system and flush the cooling system before the recommended maintenance interval if the following conditions exist:

- The engine overheats frequently.
- Foaming is observed.
- The oil has entered the cooling system and the coolant is contaminated.
- The fuel has entered the cooling system and the coolant is contaminated.

NOTICE
Use of commercially available cooling system cleaners may cause damage to cooling system components. Use only cooling system cleaners that are approved for Caterpillar engines.

Note: Inspect the water pump and the water temperature regulator after the cooling system has been drained. This is a good opportunity to replace the water pump, the water temperature regulator and the hoses, if necessary.

Drain

⚠ WARNING

Pressurized System: Hot coolant can cause serious burns. To open the cooling system filler cap, stop the engine and wait until the cooling system components are cool. Loosen the cooling system pressure cap slowly in order to relieve the pressure.

1. Stop the engine and allow the engine to cool. Loosen the cooling system filler cap slowly in order to relieve any pressure. Remove the cooling system filler cap.
2. Open the cooling system drain valve (if equipped). If the cooling system is not equipped with a drain valve, remove one of the drain plugs.

   Allow the coolant to drain.

NOTICE
Dispose of used engine coolant properly or recycle. Various methods have been proposed to reclaim used coolant for reuse in engine cooling systems. The full distillation procedure is the only method acceptable by Caterpillar to reclaim the used coolant.

For information regarding the disposal and the recycling of used coolant, consult your Caterpillar dealer or consult Caterpillar Service Technology Group:

Outside Illinois: 1-800-542-TOOL
Inside Illinois: 1-800-541-TOOL
Canada: 1-800-523-TOOL

Flush

1. Flush the cooling system with clean water in order to remove any debris.
2. Close the drain valve (if equipped). Clean the drain plugs. Install the drain plugs. Refer to the Operation and Maintenance Manual, “Torque Specifications” topic (Maintenance Section) for more information on the proper torques.

NOTICE
Fill the cooling system no faster than 19 L (5 US gal) per minute to avoid air locks.

3. Fill the cooling system with a mixture of clean water and Caterpillar Fast Acting Cooling System Cleaner. Add 0.5 L (1 pint) of cleaner per 15 L (4 US gal) of the cooling system capacity. Install the cooling system filler cap.

4. Start and run the engine at low idle for a minimum of 30 minutes. The coolant temperature should be at least 82 °C (180 °F).

NOTICE
Improper or incomplete rinsing of the cooling system can result in damage to copper and other metal components.

To avoid damage to the cooling system, make sure to completely flush the cooling system with clear water. Continue to flush the system until all signs of the cleaning agent are gone.

5. Stop the engine and allow the engine to cool. Loosen the cooling system filler cap slowly in order to relieve any pressure. Remove the cooling system filler cap. Open the drain valve (if equipped) or remove the cooling system drain plugs. Allow the water to drain. Flush the cooling system with clean water. Close the drain valve (if equipped). Clean the drain plugs. Install the drain plugs. Refer to the Operation and Maintenance Manual, “Torque Specifications” topic (Maintenance Section) for more information on the proper torques.

Cooling Systems with Heavy Deposits or Plugging

Note: For the following procedure to be effective, there must be some active flow through the cooling system components.

1. Flush the cooling system with clean water in order to remove any debris.

2. Close the drain valve (if equipped). Clean the drain plugs. Install the drain plugs. Refer to the Operation and Maintenance Manual, “Torque Specifications” topic (Maintenance Section) for more information on the proper torques.

NOTICE
Fill the cooling system no faster than 19 L (5 US gal) per minute to avoid air locks.

3. Fill the cooling system with a mixture of clean water and Caterpillar Fast Acting Cooling System Cleaner. Add 0.5 L (1 pint) of cleaner per 3.8 to 7.6 L (1 to 2 US gal) of the cooling system capacity. Install the cooling system filler cap.

4. Start and run the engine at low idle for a minimum of 90 minutes. The coolant temperature should be at least 82 °C (180 °F).

NOTICE
Improper or incomplete rinsing of the cooling system can result in damage to copper and other metal components.

To avoid damage to the cooling system, make sure to completely flush the cooling system with clear water. Continue to flush the system until all signs of the cleaning agent are gone.

5. Stop the engine and allow the engine to cool. Loosen the cooling system filler cap slowly in order to relieve any pressure. Remove the cooling system filler cap. Open the drain valve (if equipped) or remove the cooling system drain plugs. Allow the water to drain. Flush the cooling system with clean water. Close the drain valve (if equipped). Clean the drain plugs. Install the drain plugs. Refer to the Operation and Maintenance Manual, “Torque Specifications” topic (Maintenance Section) for more information on the proper torques.

Fill

NOTICE
Fill the cooling system no faster than 19 L (5 US gal) per minute to avoid air locks.

1. Fill the cooling system with coolant/antifreeze. Refer to the Operation and Maintenance Manual, “Cooling System Specifications” topic (Maintenance Section) for more information on cooling system specifications. Do not install the cooling system filler cap.

2. Start and run the engine at low idle. Increase the engine rpm to 1500 rpm. Run the engine at high idle for one minute in order to purge the air from the cavities of the engine block. Stop the engine.

3. Check the coolant level. Maintain the coolant level within 13 mm (0.5 inch) below the bottom of the pipe for filling. Maintain the coolant level within 13 mm (0.5 inch) to the proper level on the sight glass (if equipped).

4. Clean the cooling system filler cap. Inspect the gasket that is on the cooling system filler cap. If the gasket that is on the cooling system filler cap is damaged, discard the old cooling system filler cap and install a new cooling system filler cap. If the gasket that is on the cooling system filler cap is not damaged, perform a pressure test. A 9S-8140 Pressurizing Pump is used to perform the pressure test. The correct pressure for the cooling system filler cap is stamped on the face of the cooling system filler cap. If the cooling system filler cap does not retain the correct pressure, install a new cooling system filler cap.

5. Start the engine. Inspect the cooling system for leaks and for proper operating temperature.

i01206445

Cooling System Coolant (ELC) - Change

SMCS Code: 1350-070; 1395-044

Clean the cooling system and flush the cooling system before the recommended maintenance interval if the following conditions exist:

- The engine overheats frequently.
- Foaming is observed.
- The oil has entered the cooling system and the coolant is contaminated.
- The fuel has entered the cooling system and the coolant is contaminated.

Note: When the cooling system is cleaned, only clean water is needed when the ELC is drained and replaced.

Note: Inspect the water pump and the water temperature regulator after the cooling system has been drained. This is a good opportunity to replace the water pump, the water temperature regulator and the hoses, if necessary.

Drain

⚠ WARNING

Pressurized System: Hot coolant can cause serious burns. To open the cooling system filler cap, stop the engine and wait until the cooling system components are cool. Loosen the cooling system pressure cap slowly in order to relieve the pressure.

1. Stop the engine and allow the engine to cool. Loosen the cooling system filler cap slowly in order to relieve any pressure. Remove the cooling system filler cap.

2. Open the cooling system drain valve (if equipped). If the cooling system is not equipped with a drain valve, remove the cooling system drain plugs.

   Allow the coolant to drain.

NOTICE

Dispose of used engine coolant properly or recycle. Various methods have been proposed to reclaim used coolant for reuse in engine cooling systems. The full distillation procedure is the only method acceptable by Caterpillar to reclaim the used coolant.

For information regarding the disposal and the recycling of used coolant, consult your Caterpillar dealer or consult Caterpillar Service Technology Group:

Outside Illinois: 1-800-542-TOOL
Inside Illinois: 1-800-541-TOOL
Canada: 1-800-523-TOOL

Flush

1. Flush the cooling system with clean water in order to remove any debris.

2. Close the drain valve (if equipped). Clean the drain plugs. Install the drain plugs. Refer to the Operation and Maintenance Manual, “Torque Specifications” topic (Maintenance Section) for more information on the proper torques.

NOTICE

Fill the cooling system no faster than 19 L (5 US gal) per minute to avoid air locks.

3. Fill the cooling system with clean water. Install the cooling system filler cap.

4. Start and run the engine at low idle until the temperature reaches 49 to 66 °C (120 to 150 °F).

5. Stop the engine and allow the engine to cool. Loosen the cooling system filler cap slowly in order to relieve any pressure. Remove the cooling system filler cap. Open the drain valve (if equipped) or remove the cooling system drain plugs. Allow the water to drain. Flush the cooling system with clean water. Close the drain valve (if equipped). Clean the drain plugs. Install the drain plugs. Refer to the Operation and Maintenance Manual, “Torque Specifications” topic (Maintenance Section) for more information on the proper torques.

Fill

NOTICE
Fill the cooling system no faster than 19 L (5 US gal) per minute to avoid air locks.

1. Fill the cooling system with Extended Life Coolant (ELC). Refer to the Operation and Maintenance Manual, “Cooling System Specifications” topic (Maintenance Section) for more information on cooling system specifications. Do not install the cooling system filler cap.

2. Start and run the engine at low idle. Increase the engine rpm to high idle. Run the engine at high idle for one minute in order to purge the air from the cavities of the engine block. Stop the engine.

3. Check the coolant level. Maintain the coolant level within 13 mm (0.5 inch) below the bottom of the pipe for filling. Maintain the coolant level within 13 mm (0.5 inch) to the proper level on the sight glass (if equipped).

4. Clean the cooling system filler cap. Inspect the gasket that is on the cooling system filler cap. If the gasket that is on the cooling system filler cap is damaged, discard the old cooling system filler cap and install a new cooling system filler cap. If the gasket that is on the cooling system filler cap is not damaged, use a 9S-8140 Pressurizing Pump in order to pressure test the cooling system filler cap. The correct pressure for the cooling system filler cap is stamped on the face of the cooling system filler cap. If the cooling system filler cap does not retain the correct pressure, install a new cooling system filler cap.

5. Start the engine. Inspect the cooling system for leaks and for proper operating temperature.

i00259474

Cooling System Coolant Extender (ELC) - Add

SMCS Code: 1352-045; 1395-081

Caterpillar Extended Life Coolant (ELC) does not require the frequent Supplemental Coolant Additive (SCA) additions associated with the present conventional coolants. The Extender only needs to be added once.

Check the cooling system only when the engine is stopped and cool.

1. Loosen the cooling system filler cap slowly in order to relieve pressure. Remove the cooling system filler cap.

2. It may be necessary to drain enough coolant from the cooling system in order to add the Extender.

3. Add Extender according to the requirements for your engine’s cooling system capacity. Refer to the Operation and Maintenance Manual, “Refill Capacities” in the Maintenance Section for the capacity of the cooling system for your engine. Refer to the Operation and Maintenance Manual, “Cooling System Specifications” information for the Caterpillar ELC Extender additions.

4. Clean the cooling system filler cap. Inspect the cooling system filler cap gaskets. Replace the cooling system filler cap if the cooling system filler cap gaskets are damaged. Install the cooling system filler cap.

i01197583

Cooling System Coolant Level - Check

SMCS Code: 1395-082

Check the coolant level when the engine is stopped and cool.

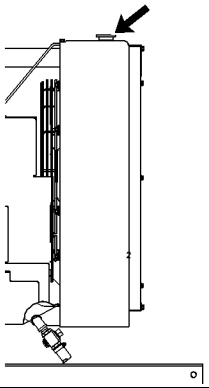


Illustration 32 g00285520

Cooling system filler cap

⚠ WARNING

Pressurized System: Hot coolant can cause serious burns. To open the cooling system filler cap, stop the engine and wait until the cooling system components are cool. Loosen the cooling system pressure cap slowly in order to relieve the pressure.

1. Remove the cooling system filler cap slowly in order to relieve pressure.
2. Maintain the coolant level within 13 mm (0.5 inch) of the bottom of the filler pipe. If the engine is equipped with a sight glass, maintain the coolant level to the proper level in the sight glass.

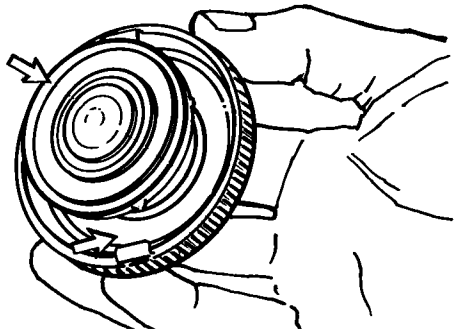


Illustration 33 g00103639

Typical filler cap gaskets

3. Clean the cooling system filler cap and check the condition of the filler cap gaskets. Replace the cooling system filler cap if the filler cap gaskets are damaged. Reinstall the cooling system filler cap.
4. Inspect the cooling system for leaks.

i00992487

Cooling System Supplemental Coolant Additive (SCA) - Test/Add

SMCS Code: 1352-045; 1395-081

⚠ WARNING

Cooling system coolant additive contains alkali. To help prevent personal injury, avoid contact with the skin and the eyes. Do not drink cooling system coolant additive.

Note: Test the concentration of the Supplemental Coolant Additive (SCA) or test the SCA concentration as part of an S·O·S Coolant Analysis.

Test for SCA Concentration

Coolant/Antifreeze and SCA

NOTICE
Do not exceed the recommended six percent supplemental coolant additive concentration.

Use the 8T-5296 Coolant Conditioner Test Kit or use the 4C-9301 Coolant Conditioner Test Kit in order to check the concentration of the SCA. Refer to the Operation and Maintenance Manual for more information on conventional coolant/antifreeze cooling system maintenance.

Water and SCA

NOTICE
Do not exceed the recommended eight percent supplemental coolant additive concentration.

Test the concentration of the SCA with the 8T-5296 Coolant Conditioner Test Kit. Refer to the Operation and Maintenance Manual, “Water/Supplemental Coolant Additive (SCA)” topic (Maintenance Section). Refer to the Operation and Maintenance Manual, “Conventional Coolant/Antifreeze Cooling System Maintenance” topic (Maintenance Section).

S·O·S Coolant Analysis

S·O·S coolant samples can be analyzed at your Caterpillar dealer. S·O·S Coolant Analysis is a program that is based on periodic samples.

Level 1

Level 1 is a basic analysis of the coolant. The following items are tested:

- Glycol Concentration
- Concentration of SCA
- pH
- Conductivity

The results are reported, and recommendations are made according to the results. Consult your Caterpillar dealer for information on the benefits of managing your equipment with an S·O·S Coolant Analysis.

Add the SCA, If Necessary

NOTICE
Do not exceed the recommended amount of supplemental coolant additive concentration. Excessive supplemental coolant additive concentration can form deposits on the higher temperature surfaces of the cooling system, reducing the engine's heat transfer characteristics. Reduced heat transfer could cause cracking of the cylinder head and other high temperature components. Excessive supplemental coolant additive concentration could also result in radiator tube blockage, overheating, and/or accelerated water pump seal wear. Never use both liquid supplemental coolant additive and the spin-on element (if equipped) at the same time. The use of those additives together could result in supplemental coolant additive concentration exceeding the recommended maximum.

⚠ WARNING

Pressurized System: Hot coolant can cause serious burns. To open the cooling system filler cap, stop the engine and wait until the cooling system components are cool. Loosen the cooling system pressure cap slowly in order to relieve the pressure.

1. Slowly loosen the cooling system filler cap in order to relieve the pressure. Remove the cooling system filler cap.

Note: Always discard drained fluids according to local regulations.

2. If necessary, drain some coolant from the cooling system into a suitable container in order to allow space for the extra SCA.
3. Add the proper amount of SCA. Refer to the Operation and Maintenance Manual for more information on SCA requirements.
4. Clean the cooling system filler cap. Inspect the gaskets of the cooling system filler cap. If the gaskets are damaged, replace the old cooling system filler cap with a new cooling system filler cap. Install the cooling system filler cap.

i00912898

Cooling System Water Temperature Regulator - Replace

SMCS Code: 1355-510

Replace the water temperature regulator before the water temperature regulator fails. This is a recommended preventive maintenance practice. Replacing the water temperature regulator reduces the chances for unscheduled downtime.

A water temperature regulator that fails in a partially opened position can cause overheating or overcooling of the engine.

A water temperature regulator that fails in the closed position can cause excessive overheating. Excessive overheating could result in cracking of the cylinder head or piston seizure problems.

A water temperature regulator that fails in the open position will cause the engine operating temperature to be too low during partial load operation. Low engine operating temperatures during partial loads could cause an excessive carbon buildup inside the cylinders. This excessive carbon buildup could result in an accelerated wear of the piston rings and wear of the cylinder liner.

NOTICE
Failure to replace your water temperature regulator on a regularly scheduled basis could cause severe engine damage.

Caterpillar engines incorporate a shunt design cooling system and require operating the engine with a water temperature regulator installed.

If the water temperature regulator is installed incorrectly, the engine may overheat, causing cylinder head damage. Ensure that the new water temperature regulator is installed in the original position. Ensure that the water temperature regulator vent hole is open.

Do not use liquid gasket material on the gasket or cylinder head surface.

Refer to the Service Manual for the replacement procedure of the water temperature regulator, or consult your Caterpillar dealer.

Note: If only the water temperature regulators are replaced, drain the coolant from the cooling system to a level that is below the water temperature regulator housing.

i00894991

Crankshaft Vibration Damper - Inspect

SMCS Code: 1205-040

Damage to the crankshaft vibration damper or failure of the crankshaft vibration damper can increase torsional vibrations. This can result in damage to the crankshaft and to other engine components. A deteriorating damper can cause excessive gear train noise at variable points in the speed range.

The damper is mounted to the crankshaft which is located behind the belt guard on the front of the engine.

Rubber Damper

Your engine may be equipped with a rubber damper. The rubber damper uses a ring which is mounted in rubber in order to reduce vibrations in the crankshaft.

Inspect the damper and repair or replace the damper for any of the following reasons:

- There is deterioration and cracking of the rubber.
- There is slippage of the outer ring from the original position.
- The engine has had a failure because of a broken crankshaft.
- Analysis of the oil has revealed that the front main bearing is badly worn.
- There is a large amount of gear train wear that is not caused by lack of oil.

Refer to the Service Manual or consult your Caterpillar dealer for information about damper replacement.

Visconic Damper

Your engine may be equipped with a visconic damper. The visconic damper has a weight that is located inside a fluid filled case. The weight moves in the case in order to limit torsional vibration.

Inspect the damper for evidence of fluid leaks. If a fluid leak is found, determine the type of fluid. The fluid in the damper is silicone. Silicone has the following characteristics: transparent, viscous, smooth, and difficult to remove from surfaces.

If the fluid leak is oil, inspect the crankshaft seals for leaks. If a leak is observed, replace the crankshaft seals.

Inspect the damper and repair or replace the damper for any of the following reasons:

- The damper is dented, cracked, or leaking.
- The paint on the damper is discolored from heat.
- The engine has had a failure because of a broken crankshaft.
- Analysis of the oil has revealed that the front main bearing is badly worn.
- There is a large amount of gear train wear that is not caused by a lack of oil.

Refer to the Service Manual or consult your Caterpillar dealer for information about damper replacement.

i00174798

Driven Equipment - Check

SMCS Code: 3279-535

Refer to the OEM specifications for more information on the following maintenance recommendations for the driven equipment:

- Inspection
- Adjustment
- Lubrication
- Other maintenance recommendations

Perform any maintenance for the driven equipment which is recommended by the OEM.

i01239442

Engine - Clean

SMCS Code: 1000-070

⚠ WARNING

Personal injury or death can result from high voltage.

Moisture can create paths of electrical conductivity.

Make sure that the electrical system is OFF. Lock out the starting controls and tag the controls "DO NOT OPERATE".

NOTICE
Water and/or condensation can cause damage to electrical components. Protect all electrical components from exposure to water.

NOTICE
Accumulated grease and oil on an engine is a fire hazard. Keep the engine clean. Remove debris and fluid spills whenever a significant quantity accumulates on the engine.

Periodic cleaning of the engine is recommended. Steam cleaning the engine will remove accumulated oil and grease. A clean engine provides the following benefits:

- Easy detection of fluid leaks
- Maximum heat transfer characteristics
- Ease of maintenance

i01173387

Engine Air Cleaner Element (Single Element) - Inspect/Replace

SMCS Code: 1054-040; 1054-510

Perform the Operation and Maintenance Manual, "Engine Air Cleaner Service Indicator-Inspect" procedure and perform the Operation and Maintenance Manual, "Engine Air Precleaner Check/Clean" procedure (if equipped) before performing the following procedure.

NOTICE
Never run the engine without an air cleaner element installed. Never run the engine with a damaged air cleaner element. Do not use air cleaner elements with damaged pleats, gaskets or seals. Dirt entering the engine causes premature wear and damage to engine components. Air cleaner elements help to prevent airborne debris from entering the air inlet.

NOTICE
Never service the air cleaner element with the engine running since this will allow dirt to enter the engine.

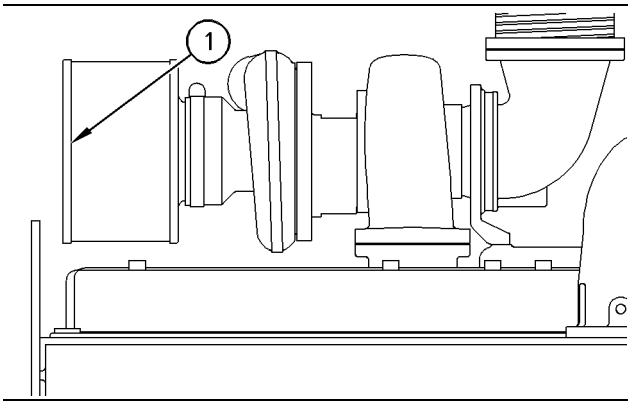


Illustration 34 g00310663

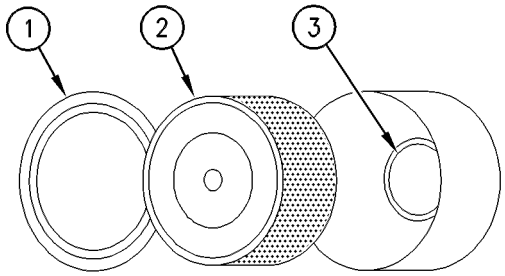


Illustration 35 g00310664

1. Remove the air cleaner cover (1) and remove the element (2).
2. Seal the air inlet (3) so that debris cannot enter the air inlet. Tape or a clean cloth can be used to cover the opening.
3. Clean the inside of the air cleaner cover. Clean the body that holds the air cleaner element.
4. Inspect the replacement element for the following items:damage, dirt, and debris.
5. Remove the seal from the opening of the air inlet.

6. Install a clean, undamaged element.

7. Install the air cleaner cover (1).

8. Reset the service indicator.

i01175055

Engine Air Cleaner Service Indicator - Inspect

SMCS Code: 7452-040

Some engines may be equipped with a different service indicator.

Some engines are equipped with a differential gauge for inlet air pressure. The differential gauge for inlet air pressure displays the difference in the pressure that is measured before the air cleaner element and the pressure that is measured after the air cleaner element. As the air cleaner element becomes dirty, the pressure differential rises. If your engine is equipped with a different type of service indicator, follow the OEM recommendations in order to service the air cleaner service indicator.

The service indicator may be mounted on the air cleaner element or in a remote location.

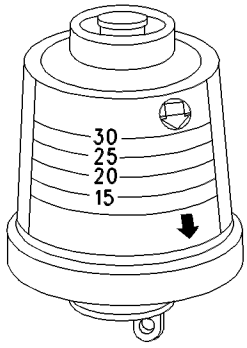


Illustration 36 g00103777

Typical service indicator

Observe the service indicator. The air cleaner element should be cleaned or the air cleaner element should be replaced when one of the following conditions occur:

- The yellow diaphragm enters the red zone.
- The red piston locks in the visible position.

Test the Service Indicator

Service indicators are important instruments.

- Check for ease of resetting. The service indicator should reset in less than three pushes.
- Check the movement of the yellow core when the engine is accelerated to the engine rated speed. The yellow core should latch approximately at the greatest vacuum that is attained.

If the service indicator does not reset easily, or if the yellow core does not latch at the greatest vacuum, the service indicator should be replaced. If the new service indicator will not reset, the hole for the service indicator may be plugged.

The service indicator may need to be replaced frequently in environments that are severely dusty, if necessary. Replace the service indicator annually regardless of the operating conditions. Replace the service indicator when the engine is overhauled, and whenever major engine components are replaced.

Note: When a new service indicator is installed, excessive force may crack the top of the service indicator. Tighten the service indicator to a torque of 2 N·m (18 lb in).

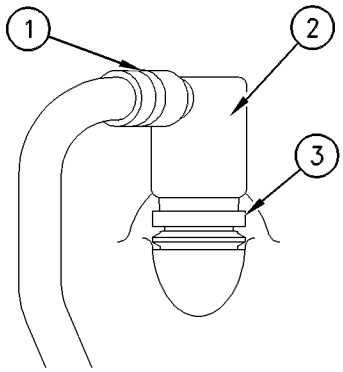
i00906289

Engine Crankcase Breather - Clean

SMCS Code: 1317-070

NOTICE
Perform this maintenance with the engine stopped.

If the crankcase breather is not maintained on a regular basis, the crankcase breather will become plugged. A plugged crankcase breather will cause excessive crankcase pressure that may cause crankshaft seal leakage.



g00463048

Illustration 37

Typical example

(1) Hose clamp
(2) Breather assembly
(3) Retaining clamp

1. Loosen hose clamp (1) and remove the hose from breather assembly (2).

2. Loosen the retaining clamp (3). Remove breather assembly (2) and the seal.

3. Wash the breather element in solvent that is clean and nonflammable. Allow the breather element to dry before installation.

4. Install a breather element that is clean and dry. Install breather assembly and seal (2) and install clamp (3). Refer to the Operation and Maintenance Manual, “Torque Specifications” topic (Maintenance Section) for the proper torques.

5. Install the hose. Install hose clamp (1). Refer to the Operation and Maintenance Manual, “Torque Specifications” topic (Maintenance Section) for the proper torques.

i00687861

Engine Mounts - Inspect

SMCS Code: 1152-040

Inspect the engine mounts for deterioration and for proper bolt torque. Engine vibration can be caused by the following conditions:

- Improper mounting of the engine
- Deterioration of the engine mounts

Any engine mount that shows deterioration should be replaced. Refer to the Service Manual for the recommended torques. Refer to your Caterpillar dealer for more information.

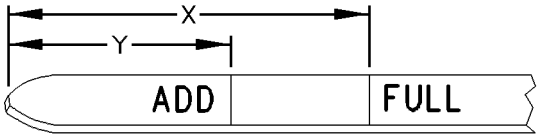
i00623423

Engine Oil Level - Check

SMCS Code: 1348-535-FLV

⚠ WARNING

Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact the skin.



g00110310

Illustration 38

(Y) “ADD” mark. (X) “FULL” mark.

NOTICE
Perform this maintenance with the engine stopped.

1. Maintain the oil level between “ADD” mark (Y) and “FULL” mark (X) on oil level gauge (1). Do not fill the crankcase above “FULL” mark (X).

NOTICE
Operating your engine when the oil level is above the “FULL” mark could cause your crankshaft to dip into the oil. The air bubbles created from the crankshaft dipping into the oil reduces the oil’s lubricating characteristics and could result in the loss of power.

2. Remove the oil filler cap and add oil, if necessary. Clean the oil filler cap. Install the oil filler cap.

i01070756

Engine Oil Sample - Obtain

SMCS Code: 1000-008; 1348-554-SM; 7542-554-OC, SM

In addition to a good preventive maintenance program, Caterpillar recommends using S·O·S oil analysis at regularly scheduled intervals in order to monitor the condition of the engine and the maintenance requirements of the engine.

Obtain the Sample and the Analysis

⚠ WARNING

Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact the skin.

Before you take the oil sample, complete the Label, PEEP5031 for identification of the sample. In order to help obtain the most accurate analysis, provide the following information:

- Engine model
- Service hours on the engine
- The number of hours that have accumulated since the last oil change
- The amount of oil that has been added since the last oil change

To ensure that the sample is representative of the oil in the crankcase, obtain a warm, well mixed oil sample.

To avoid contamination of the oil samples, the tools and the supplies that are used for obtaining oil samples must be clean.

Caterpillar recommends using the sampling valve in order to obtain oil samples. The quality and the consistency of the samples are better when the sampling valve is used. The location of the sampling valve allows oil that is flowing under pressure to be obtained during normal engine operation.

The 8T-9190 Fluid Sampling Bottle Group is recommended for use with the sampling valve. The bottle group includes the parts that are needed for obtaining oil samples. Instructions are also provided.

NOTICE

Do not use the same vacuum sampling pump for extracting oil samples that is used for extracting coolant samples.

A small residue of either type sample may remain in the pump and may cause a false positive analysis for the sample being taken.

Always use a designated pump for oil sampling and a designated pump for coolant sampling.

Failure to do so may cause a false analysis which could lead to customer and dealer concerns.

If the engine is not equipped with a sampling valve, use the 1U-5718 Vacuum Pump. The pump is designed to accept sampling bottles. Disposable tubing must be attached to the pump for insertion into the sump.

For instructions, see Special Publication, PEHP6001, “How To Take A Good Oil Sample”. Consult your Caterpillar dealer for complete information and assistance in establishing an S·O·S program for your engine.

i00652130

Engine Oil and Filter - Change

SMCS Code: 1318-510; 1348-044

⚠ WARNING

Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact the skin.

Do not drain the oil when the engine is cold. As the oil cools, suspended waste particles settle on the bottom of the oil pan. The waste particles are not removed with the draining cold oil. Drain the crankcase with the engine stopped. Drain the crankcase with the oil warm. This draining method allows the waste particles that are suspended in the oil to be drained properly.

Failure to follow this recommended procedure will cause the waste particles to be recirculated through the engine lubrication system with the new oil.

Drain the Engine Oil

After the engine has been run at the normal operating temperature, stop the engine. Use one of the following methods to drain the engine crankcase oil:

- If the engine is equipped with a drain valve, turn the drain valve knob counterclockwise in order to drain the oil. After the oil has drained, turn the drain valve knob clockwise in order to close the drain valve.
- If the engine is not equipped with a drain valve, remove the oil drain plug in order to allow the oil to drain. If the engine is equipped with a shallow sump, remove the bottom oil drain plugs from both ends of the oil pan.

After the oil has drained, the oil drain plugs should be cleaned and installed.

Replace the Oil Filter

NOTICE
Caterpillar oil filters are built to Caterpillar specifications. Use of an oil filter not recommended by Caterpillar could result in severe engine damage to the engine bearings, crankshaft, etc., as a result of the larger waste particles from unfiltered oil entering the engine lubricating system. Only use oil filters recommended by Caterpillar.

1. Remove the oil filter with a 1U-8760 Chain Wrench.

2. Cut the oil filter open with a 4C-5084 Oil Filter Cutter. Break apart the pleats and inspect the oil filter for metal debris. An excessive amount of metal debris in the oil filter may indicate early wear or a pending failure.

   Use a magnet to differentiate between the ferrous metals and the nonferrous metals that are found in the oil filter element. Ferrous metals may indicate wear on the steel and cast iron parts of the engine.

   Nonferrous metals may indicate wear on the aluminum parts, brass parts or bronze parts of the engine. Parts that may be affected include the following items: main bearings, rod bearings, turbocharger bearings, and cylinder heads.

   Due to normal wear and friction, it is not uncommon to find small amounts of debris in the oil filter. Consult your Caterpillar dealer in order to arrange for a further analysis if an excessive amount of debris is found in the oil filter.

g00103713

Illustration 39
Typical filter mounting base and filter gasket

3. Clean the sealing surface of the filter mounting base. Ensure that all of the old oil filter gasket is removed.

4. Apply clean engine oil to the new oil filter gasket.

NOTICE
Do not fill the oil filters with oil before installing them. This oil would not be filtered and could be contaminated. Contaminated oil can cause accelerated wear to engine components.

5. Install the oil filter. Tighten the oil filter until the oil filter gasket contacts the base. Tighten the oil filter by hand according to the instructions that are shown on the oil filter. Do not overtighten the oil filter.

Fill the Engine Crankcase

1. Remove the oil filler cap. Refer to the Operation and Maintenance Manual for more information on lubricant specifications. Fill the crankcase with the proper amount of oil. Refer to the Operation and Maintenance Manual for more information on refill capacities.

NOTICE
If equipped with an auxiliary oil filter system or a remote oil filter system, follow the OEM or filter manufacturer's recommendations. Under filling or overfilling the crankcase with oil can cause engine damage.

NOTICE
To prevent crankshaft bearing damage, crank the engine with the fuel OFF. This will fill the oil filters before starting the engine. Do not crank the engine for more than 30 seconds.

2. Start the engine and run the engine at "LOW IDLE" for two minutes. Perform this procedure in order to ensure that the lubrication system has oil and that the oil filters are filled. Inspect the oil filter for oil leaks.

3. Stop the engine and allow the oil to drain back to the sump for a minimum of ten minutes.

4. Remove the oil level gauge in order to check the oil level. Maintain the oil level between the "ADD" and "FULL" marks on the oil level gauge.

i00626013

Engine Protective Devices - Check

SMCS Code: 7400-535

Alarms and shutoffs must function properly. Alarms provide timely warning to the operator. Shutoffs help to prevent damage to the engine. It is impossible to determine if the engine protective devices are in good working order during normal operation. Malfunctions must be simulated in order to test the engine protective devices.

A calibration check of the engine protective devices will ensure that the alarms and shutoffs activate at the setpoints. Ensure that the engine protective devices are functioning properly.

NOTICE
During testing, abnormal operating conditions must be simulated.

The tests must be performed correctly in order to prevent possible damage to the engine.

To prevent damage to the engine, only authorized service personnel or your Caterpillar dealer should perform the tests.

Visual Inspection

Visually check the condition of all gauges, sensors and wiring. Look for wiring and components that are loose, broken, or damaged. Damaged wiring or components should be repaired or replaced immediately.

i00869628

Engine Valve Lash - Inspect/Adjust

SMCS Code: 1102-025

The initial valve lash adjustment on new engines, rebuilt engines, or remanufactured engines is recommended at the first scheduled oil change. The adjustment is necessary due to the initial wear of the valve train components and to the seating of the valve train components.

This maintenance is recommended by Caterpillar as part of a lubrication and preventive maintenance schedule in order to help provide maximum engine life.

NOTICE
Only qualified service personnel should perform this maintenance. Refer to the Service Manual or your Caterpillar dealer for the complete valve lash adjustment procedure.

Operation of Caterpillar engines with improper valve adjustments can reduce engine efficiency. This reduced efficiency could result in excessive fuel usage and/or shortened engine component life.

⚠ WARNING

Ensure that the engine can not be started while this maintenance is being performed. To help prevent possible injury, do not use the starting motor to turn the flywheel.

Hot engine components can cause burns. Allow additional time for the engine to cool before measuring/adjusting valve lash clearance.

Ensure that the engine is stopped before measuring the valve lash. To obtain an accurate measurement, allow the valves to cool before this maintenance is performed.

Refer to the Service Manual for more information.

i00937014

Engine Valve Rotators - Inspect

SMCS Code: 1109-040

⚠ WARNING

When inspecting the valve rotators, protective glasses or face shield and protective clothing must be worn, to help prevent being burned by hot oil or spray.

NOTICE
A valve rotator which does not operate properly will accelerate valve face wear and valve seat wear and shorten valve life. If a damaged rotator is not replaced, valve face guttering could result and cause pieces of the valve to fall into the cylinder. This can cause piston and cylinder head damage.

Valve rotators cause the valves to rotate when the engine runs. This helps to prevent deposits from building up on the valves and the valve seats.

Perform the following steps after the valve lash is set, but before the valve covers are installed:

1. Start the engine according to this Operation and Maintenance Manual, “Engine Starting” procedure (Operation Section).

Operate the engine at low idle.

2. Observe the top surface of each valve rotator. The valve rotators should turn slightly when the valves close.

If a valve fails to rotate, consult your Caterpillar dealer.

i00175571

Fan Drive Bearing - Lubricate

SMCS Code: 1359-086-BD

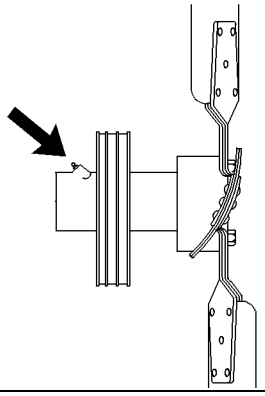


Illustration 40 g00123252

Typical Fan Drive Bearing Grease Fitting

Lubricate the fan drive bearing grease fitting with Bearing Lubricant Special Purpose Grease or the equivalent.

Inspect the fan drive pulley assembly. If the shaft is loose, an inspection of the internal components should be performed. Refer to the Service Manual.

i01370585

Fuel Control Linkage - Check/Lubricate

SMCS Code: 1257-086; 1257-535

Check the fuel control linkage for proper operation. If necessary, adjust the fuel control linkage . Refer to the Service Manual for the adjustment procedures.

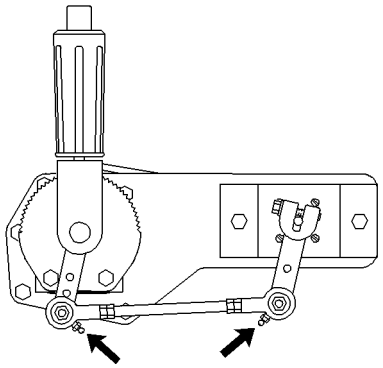


Illustration 41 g00723120

Typical grease fittings on the fuel control linkage

Some fuel control linkages require lubrication. Lubricate the grease fittings with 1P-0808 Multipurpose Grease or the equivalent.

i00626014

Fuel Injection Nozzles - Test/Exchange

SMCS Code: 1254-013; 1254-081

⚠ WARNING

Fuel leaked or spilled onto hot surfaces or electrical components can cause a fire.

NOTICE

Do not allow dirt to enter the fuel system. Thoroughly clean the area around a fuel system component that will be disconnected. Fit a suitable cover over disconnected fuel system component.

Fuel injection nozzles are subject to tip wear. Tip wear is a result of fuel contamination. Tip wear can cause the following problems:

- Increased fuel consumption
- Black smoke
- Misfire
- Rough running

Fuel Injection nozzles should be cleaned, inspected, tested, and replaced, if necessary. Refer to Special Instruction, SEHS7292 for using the 8S-2245 Injection Cleaning Tool Group. Consult your Caterpillar dealer about cleaning the fuel injection nozzle and testing the fuel injection nozzle.

NOTICE
Never wire brush or scrape a fuel injection nozzle. Wire brushing or scraping a fuel injection nozzle will damage the finely machine orifice. Proper tools for cleaning and testing the fuel injection nozzles can be obtained from Caterpillar dealers.

The following items are symptoms of a malfunction of the fuel injection nozzle:

- Abnormal engine operation
- Smoke emission
- Engine knock

Each fuel injection nozzle must be isolated one at a time in order to determine the malfunctioning fuel injection nozzle.

1. Start the engine.
2. Loosen each fuel line nut one at a time at the fuel injection pump. A cloth or similar material must be used in order to prevent fuel from spraying on the hot exhaust components. Tighten each nut before loosening the next nut.
3. A defective fuel injection nozzle may be identified when a fuel line nut is loosened and the following conditions are present:
   - The exhaust smoke is partially eliminated or the exhaust smoke is completely eliminated.
   - Engine performance is not affected.

   A fuel injection nozzle that is suspected of being defective should be removed. A new fuel injection nozzle should be installed in the cylinder in order to determine if the removed fuel injection nozzle is defective.

Removal and Installation of the Fuel Injection Nozzles

For the removal and the installation of fuel injection nozzles, special tooling is required. Refer to the Service Manual for more information. Consult your Caterpillar dealer for assistance.

i00908934

Fuel Ratio Control - Inspect/Adjust

SMCS Code: 1278-025; 1278-040

Slow engine response and low power may indicate a need for adjustment or repair of the fuel ratio control. Refer to the Service Manual or your Caterpillar dealer for the complete adjustment procedure on the fuel ratio control.

i00891826

Fuel System - Prime

SMCS Code: 1258-548

⚠ WARNING

Personal injury or death can result from a fire.

Fuel leaked or spilled onto hot surfaces or electrical components can cause a fire.

Clean up all leaked or spilled fuel. Do not smoke while working on the fuel system.

Turn the disconnect switch OFF or disconnect the battery when changing fuel filters.

Prime the fuel system in order to fill dry fuel filters. You must also prime the fuel system after any one of the following conditions exist:

- The fuel system has run dry.
- The engine has been in prolonged storage.
- The fuel filter has been cleaned.
- The fuel filter has been replaced.

Note: If the engine does not have a fuel priming pump, refer to Step 4.

1. Unlock the priming pump, and operate the priming pump until a resistance is felt. This procedure will probably require a considerable amount of priming.
2. Push in the plunger, and hand tighten the plunger.

NOTICE
Do not crank the engine for more than 30 seconds. Allow the starter to cool for two minutes before cranking again. Turbocharger damage can result if the engine rpm is not kept low until the oil gauge display verifies that the oil pressure is sufficient.

3. Crank the engine.

If the engine starts and the engine runs rough, run the engine at low idle. Continue running the engine until the engine runs smoothly.

NOTICE
During periodic service, DO NOT remove the fuel filter plug that is in the fuel filter base in order to purge air from the fuel system. The periodic removal of the fuel filter plug will result in increased wear on the threads in the fuel filter base. This wear leads to fuel leakage.

4. Open the vent valve (if equipped) on the fuel injection pump's housing.

5. Operate the priming pump until the flow of fuel from the vent valve is continuous and the flow of fuel is free of air bubbles.

If the engine does not have a fuel priming pump, crank the engine. Crank the engine until the fuel flows freely and until the fuel is free of air bubbles.

6. Close the vent valve. Then, push in the plunger. Hand tighten the plunger.

7. Crank the engine. If the engine starts and if the engine runs rough, run the engine at low idle. Continue running the engine until the engine runs smoothly.

Note: If the engine will not start, more priming is necessary. If the engine continues to run rough, more priming is necessary as well.

NOTICE
Do not let the tops of fuel nozzles turn when the fuel line nuts are loosened or tightened.

The nozzles will be damaged if the top of the nozzle turns in the body.

The engine will be damaged if a defective fuel injection nozzle is used because the shape of fuel (spray pattern) that comes out of the nozzles will not be correct.

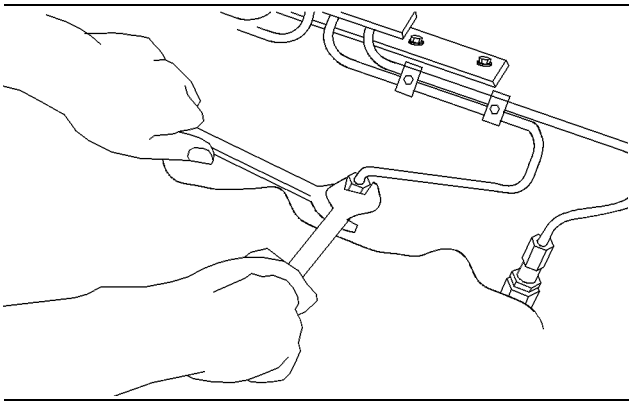


Illustration 42 g00290109

8. Loosen the fuel line nuts at the valve cover base. Loosen these line nuts one at a time.

9. Operate the priming pump until the flow of fuel from the fuel line is continuous and the flow of fuel is free of air bubbles.

10. Push in the plunger, and hand tighten the plunger. If the engine does not have a fuel priming pump, crank the engine.

11. Tighten each fuel line nut before you loosen the next fuel line nut. Tighten the fuel line nuts to a torque of 40 ± 7 N·m (30 ± 5 lb ft).

Continue this procedure until all of the fuel lines have been cleared of any air. Before you start the engine, make sure that the fuel line nuts are properly tightened. Also make sure that the priming is locked.

i00951418

Fuel System Primary Filter - Clean/Replace

SMCS Code: 1260-070; 1260-510

⚠ WARNING

Fuel leaked or spilled onto hot surfaces or electrical components can cause a fire. To help prevent possible injury, turn the start switch off when changing fuel filters or water separator elements. Clean up fuel spills immediately.

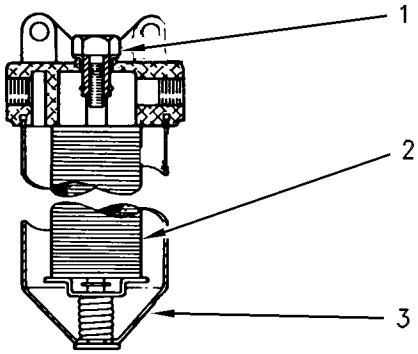
1. Stop the engine.

2. Turn the start switch to the "OFF" position. Disconnect the battery.

3. Shut off the fuel tank supply valve to the engine.

4. If the primary fuel filter is equipped with a drain valve, open the drain valve in order to drain any fuel from the filter case. Close the drain valve.

NOTICE
Use a suitable container to catch any fuel that might spill. Clean up any spilled fuel immediately.



g00485293

Illustration 43

(1) Bolt
(2) Element
(3) Case

5. Loosen the bolt (1) that is on the filter housing. Remove the filter case (3).

6. Remove the element (2) and wash the element in clean, nonflammable solvent.

NOTICE
Do not fill the fuel filters with fuel before installing them. The fuel would not be filtered and could be contaminated. Contaminated fuel will cause accelerated wear to fuel system parts.

7. Install the element (2) and the filter case (3). Tighten the bolt (1) to a torque of 24 ± 4 N·m (18 ± 3 lb ft).

i00073301

Fuel Tank Water and Sediment - Drain

SMCS Code: 1273-543-M&S

Fuel Tank

Fuel quality is critical to the performance and to the service life of the engine. Water in the fuel can cause excessive fuel system wear. Condensation occurs during the heating and cooling of fuel. The condensation occurs as the fuel passes through the fuel system and the fuel returns to the fuel tank. This causes water to accumulate in fuel tanks. Draining the fuel tank regularly and obtaining fuel from reliable sources can help to eliminate water in the fuel.

Drain the Water and the Sediment

Fuel tanks should contain some provision for draining water and draining sediment from the bottom of the fuel tanks.

Open the drain valve on the bottom of the fuel tank in order to drain the water and the sediment. Close the drain valve.

Check the fuel daily. Drain the water and sediment from the fuel tank after operating the engine or drain the water and sediment from the fuel tank after the fuel tank has been filled. Allow five to ten minutes before performing this procedure.

Fill the fuel tank after operating the engine in order to drive out moist air. This will help prevent condensation. Do not fill the tank to the top. The fuel expands as the fuel gets warm. The tank may overflow.

Some fuel tanks use supply pipes that allow water and sediment to settle below the end of the fuel supply pipe. Some fuel tanks use supply lines that take fuel directly from the bottom of the tank. If the engine is equipped with this system, regular maintenance of the fuel system filter is important.

Fuel Storage Tanks

Drain the water and the sediment from the fuel storage tank during the following conditions:

- Weekly
- Oil change
- Refill of the tank

This will help prevent water or sediment from being pumped from the storage tank into the engine fuel tank.

If a bulk storage tank has been refilled or moved recently, allow adequate time for the sediment to settle before filling the engine fuel tank. Internal baffles in the bulk storage tank will also help trap sediment. Filtering fuel that is pumped from the storage tank helps to ensure the quality of the fuel. When possible, water separators should be used.

i00907072

Hoses and Clamps - Inspect/Replace

SMCS Code: 7554-040; 7554-510

Inspect all hoses for leaks that are caused by the following conditions:

- Cracking
- Softness
- Loose clamps

Replace hoses that are cracked or soft. Tighten any loose clamps.

NOTICE
Do not bend or strike high pressure lines. Do not install bent or damaged lines, tubes or hoses. Repair any loose or damaged fuel and oil lines, tubes and hoses. Leaks can cause fires. Inspect all lines, tubes and hoses carefully. Tighten all connections to the recommended torque.

Check for the following conditions:

- End fittings that are damaged or leaking
- Outer covering that is chafed or cut
- Exposed wire that is used for reinforcement
- Outer covering that is ballooning locally
- Flexible part of the hose that is kinked or crushed
- Armoring that is embedded in the outer covering

A constant torque hose clamp can be used in place of any standard hose clamp. Ensure that the constant torque hose clamp is the same size as the standard clamp.

Due to extreme temperature changes, the hose will heat set. Heat setting causes hose clamps to loosen. This can result in leaks. A constant torque hose clamp will help to prevent loose hose clamps.

Each installation application can be different. The differences depend on the following factors:

- Type of hose
- Type of fitting material
- Anticipated expansion and contraction of the hose
- Anticipated expansion and contraction of the fittings

Replace the Hoses and the Clamps

⚠ WARNING

Pressurized System: Hot coolant can cause serious burns. To open the cooling system filler cap, stop the engine and wait until the cooling system components are cool. Loosen the cooling system pressure cap slowly in order to relieve the pressure.

1. Stop the engine. Allow the engine to cool.
2. Loosen the cooling system filler cap slowly in order to relieve any pressure. Remove the cooling system filler cap.

Note: Drain the coolant into a suitable, clean container. The coolant can be reused.

3. Drain the coolant from the cooling system to a level that is below the hose that is being replaced.
4. Remove the hose clamps.
5. Disconnect the old hose.
6. Replace the old hose with a new hose.

Note: For torques on hose clamps, see this Operation and Maintenance Manual, “Torque Specifications” (Maintenance Section).

7. Install the hose clamps with a torque wrench.

Note: For the proper coolant to use, see this Operation and Maintenance Manual, “Coolant Recommendations” (Maintenance Section).

8. Refill the cooling system.

9. Clean the cooling system filler cap. Inspect the cooling system filler cap's gaskets. Replace the cooling system filler cap if the gaskets are damaged. Install the cooling system filler cap.

10. Start the engine. Inspect the cooling system for leaks.

i01037896

Overhaul Considerations

SMCS Code: 7595-043

Reduced hours of operation at full load will result in a lower average power demand. A decreased average power demand should increase both the engine service life and the overhaul interval.

The need for an overhaul is generally indicated by increased fuel consumption and by reduced power.

The following factors are important when a decision is being made on the proper time for an engine overhaul:

- The need for preventive maintenance
- The quality of the fuel that is being used
- The operating conditions
- The results of the S·O·S analysis

Oil Consumption as an Overhaul Indicator

Oil consumption, fuel consumption, and maintenance information can be used to estimate the total operating cost for your Caterpillar engine. Oil consumption can also be used to estimate the required capacity of a makeup oil tank that is suitable for the maintenance intervals.

Oil consumption is in proportion to the percentage of the rated engine load. As the percentage of the engine load is increased, the amount of oil that is consumed per hour also increases.

The oil consumption rate (brake specific oil consumption) is measured in grams per kW/h (lb per bhp). The brake specific oil consumption (BSOC) depends on the engine load. Consult your Caterpillar dealer for assistance in determining the typical oil consumption rate for your engine.

When an engine's oil consumption has risen to three times the original oil consumption rate due to normal wear, an engine overhaul should be scheduled. There may be a corresponding increase in blowby and a slight increase in fuel consumption.

Overhaul Options

Before Failure Overhaul

A planned overhaul before failure may be the best value for the following reasons:

- Costly unplanned downtime can be avoided.
- Many original parts can be reused according to the standards for reusable parts.
- The engine's service life can be extended without the risk of a major catastrophe due to engine failure.
- The best cost/value relationship per hour of extended life can be attained.

After Failure Overhaul

If a major engine failure occurs and the engine must be removed, many options are available. An overhaul should be performed if the engine block or the crankshaft needs to be repaired.

If the engine block is repairable and/or the crankshaft is repairable, the overhaul cost should be between 40 percent and 50 percent of the cost of a new engine with a similar exchange core.

This lower cost can be attributed to three aspects:

- Specially designed Caterpillar engine features
- Caterpillar dealer exchange components
- Caterpillar Inc. remanufactured exchange components

Overhaul Recommendation

To minimize downtime, Caterpillar Inc. recommends a scheduled engine overhaul by your Caterpillar dealer before the engine fails. This will provide you with the best cost/value relationship.

Note: Overhaul programs vary according to the engine application and according to the dealer that performs the overhaul. Consult your Caterpillar dealer for specific information about the available overhaul programs and about overhaul services for extending the engine life.

If an overhaul is performed without overhaul service from your Caterpillar dealer, be aware of the following maintenance recommendations.

Rebuild or Exchange

Cylinder Head Assembly, Cylinder Packs, Oil Pump, and Fuel Transfer Pump

These components should be inspected according to the instructions that are found in various Caterpillar reusability publications. The Special Publication, SEBF8029 lists the reusability publications that are needed for inspecting the engine parts.

If the parts comply with the established inspection specifications that are expressed in the reusable parts guideline, the parts should be reused.

Parts that are not within the established inspection specifications should be dealt with in one of the following manners:

- Salvaging
- Repairing
- Replacing

Using out-of-spec parts can result in the following problems:

- Unscheduled downtime
- Costly repairs
- Damage to other engine parts
- Reduced engine efficiency
- Increased fuel consumption

Reduced engine efficiency and increased fuel consumption translates into higher operating costs. Therefore, Caterpillar Inc. recommends repairing out-of-spec parts or replacing out-of-spec parts.

Inspection and/or Replacement

Crankshaft Bearings, Valve Rotators, and Crankshaft Seals

The following components may not last until the second overhaul.

- Thrust bearings
- Main bearings
- Rod bearings
- Valve rotators
- Crankshaft seals

Caterpillar Inc. recommends the installation of new parts at each overhaul period.

Inspect these parts while the engine is disassembled for an overhaul.

Inspect the crankshaft for any of the following conditions:

- Deflection
- Damage to the journals
- Bearing material that has seized to the journals

Check the journal taper and the profile of the crankshaft journals. Check these components by interpreting the wear patterns on the following components:

- Rod bearing
- Main bearings

Inspect the camshaft for damage to the journals and to the lobes.

Note: If the camshaft is removed for any reason, use the magnetic particle inspection process to check for cracks in the camshaft.

Inspect the following components for signs of wear or for signs of scuffing:

- Camshaft bearings
- Camshaft followers

Caterpillar Inc. recommends replacing the crankshaft vibration damper.

Oil Cooler Core

During an overhaul, Caterpillar Inc. recommends the removal of the oil cooler core. Clean the oil cooler core. Then, pressure test the oil cooler core.

NOTICE

Do not use caustic cleaners to clean the core.

Caustic cleaners can attack the internal metals of the core and cause leakage.

Note: Use this cleaning procedure to clean the oil cooler core.

1. Remove the oil cooler core.

2. Remove any debris from the oil cooler core. To remove debris from the oil cooler core, turn the oil cooler core onto one end.

3. Flush the oil cooler core internally with cleaner in order to loosen foreign substances. This will also help to remove oil from the oil cooler core.

Note: Caterpillar Inc. recommends the use of Hydrosolv Liquid Cleaners. Table 35 lists the Hydrosolv Liquid Cleaners that are available from your Caterpillar dealer.

Table 35

HydrosolvLiquid Cleaners		
Part Number	**Description**	**Size**
1U-8812	Hydrosolv4165	4 L (1 US gallon)
1U-5490		19 L (5 US gallon)
8T-7570		208 L (55 US gallon)
1U-8804	Hydrosolv100	4 L (1 US gallon)
1U-5492		19 L (5 US gallon)
8T-5571		208 L (55 US gallon)

4. Use steam to clean the oil cooler core. This removes any remaining residue from the cleaner. Flush the fins of the oil cooler core. Remove any other trapped debris.

5. Wash the oil cooler core with hot, soapy water. Rinse the oil cooler core thoroughly with clean water.

⚠ WARNING

Personal injury can result from air pressure.

Personal injury can result without following proper procedure. When using pressure air, wear a protective face shield and protective clothing.

Maximum air pressure at the nozzle must be less than 205 kPa (30 psi) for cleaning purposes.

6. Dry the oil cooler core with compressed air. Direct the air in the reverse direction of the normal flow.

7. Inspect the components in order to ensure cleanliness. The oil cooler core should be pressure tested. Repair the oil cooler core, if necessary. Install the oil cooler core.

For more information about cleaning the cores, consult your Caterpillar dealer.

Obtain Coolant Analysis

The concentration of supplemental coolant additive (SCA) should be checked regularly with test kits or with S·O·S Coolant Analysis (Level 1). Further coolant analysis is recommended when the engine is overhauled.

For example, considerable deposits are found in the water jacket areas on the external cooling system, but the concentrations of coolant additives were carefully maintained. The coolant water probably contained minerals that were deposited on the engine over time.

A coolant analysis can be conducted in order to verify the condition of the water that is being used in the cooling system. A full water analysis can be obtained by consulting your local water utility company or an agricultural agent. Private laboratories are also available for water analysis.

Caterpillar Inc. recommends an S·O·S Coolant Analysis (Level 2).

S·O·S Coolant Analysis (Level 2)

An S·O·S Coolant Analysis (Level 2) is a comprehensive coolant analysis which completely analyzes the coolant and the effects on the cooling system. An S·O·S Coolant Analysis (Level 2) provides the following information:

- Complete S·O·S Coolant Analysis (Level 1)
- Visual inspection of properties
- Identification of metal corrosion
- Identification of contaminants
- Identification of built up impurities (corrosion and scale)

S·O·S Coolant Analysis (Level 2) provides a report of the results of both the analysis and the maintenance recommendations.

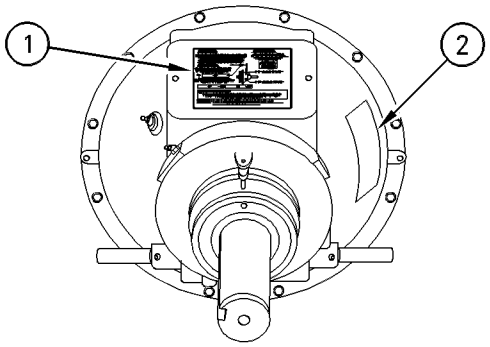
For more information about coolant analysis, see your Caterpillar dealer.

i00339617

Power Take-Off Clutch - Check/Adjust/Lubricate

SMCS Code: 3055-036; 3055-086

NOTICE
New power take-offs should have the clutch adjustment checked before being placed into service. The clutch adjustment should be checked again after the first ten hours of operation. New clutch plates have a “wear in” period, and the clutch may require several adjustments until the new plates are “worn in”.



g00108044

Illustration 44

(1) Typical instruction plate for the clutch. (2) Typical serial number plate for the clutch.

The clutch adjustment should be checked regularly after “wear in”. Heavy-duty applications which have engagements that are frequent and relatively long periods of clutch slippage require more frequent adjustment than light-duty applications. The operating torque should be measured in order to determine if a clutch adjustment is required.

Refer to the OEM information and instruction plate (1) for instructions on the following items: lubrication, adjustment, and other service recommendations. Perform the maintenance that is specified on the instruction plate.

⚠ WARNING

Do not operate the engine with the Instruction Plate cover removed from the clutch. Personal injury may result.

If the clutch is damaged to the point of burst failure, expelled pieces can cause personal injury to anyone in the immediate area. Proper safeguards must be followed to help prevent accidents.

i01206548

Radiator - Clean

SMCS Code: 1353-070

Note: Adjust the frequency of cleaning according to the effects of the operating environment.

Inspect the radiator for these items: damaged fins, corrosion, dirt, grease, insects, leaves, oil, and other debris. Clean the radiator, if necessary.

⚠ WARNING

Personal injury can result from air pressure.

Personal injury can result without following proper procedure. When using pressure air, wear a protective face shield and protective clothing.

Maximum air pressure at the nozzle must be less than 205 kPa (30 psi) for cleaning purposes.

Pressurized air is the preferred method for removing loose debris. Direct the air in the opposite direction of the fan’s air flow. Hold the nozzle approximately 6 mm (0.25 inch) away from the fins. Slowly move the air nozzle in a direction that is parallel with the tubes. This will remove debris that is between the tubes.

Pressurized water may also be used for cleaning. The maximum water pressure for cleaning purposes must be less than 275 kPa (40 psi). Use pressurized water in order to soften mud. Clean the core from both sides.

Use a degreaser and steam for removal of oil and grease. Clean both sides of the core. Wash the core with detergent and hot water. Thoroughly rinse the core with clean water.

After cleaning, start the engine and accelerate the engine to high idle rpm. This will help in the removal of debris and drying of the core. Stop the engine. Use a light bulb behind the core in order to inspect the core for cleanliness. Repeat the cleaning, if necessary.

Inspect the fins for damage. Bent fins may be opened with a “comb”. Inspect these items for good condition: welds, mounting brackets, air lines, connections, clamps, and seals. Make repairs, if necessary.

For more detailed information on cleaning and inspection, see Special Publication, SEBD0518, “Know Your Cooling System”.

i00651416

Starting Motor - Inspect

SMCS Code: 1451-040; 1453-040

Caterpillar Inc. recommends a scheduled inspection of the starting motor. If the starting motor fails, the engine may not start in an emergency situation.

Check the starting motor for proper operation. Check the electrical connections and clean the electrical connections. Refer to the Service Manual for more information on the checking procedure and for specifications or consult your Caterpillar dealer for assistance.

i00912946

Turbocharger - Inspect

SMCS Code: 1052-040

Periodic inspection and cleaning is recommended for the turbocharger compressor housing (inlet side). Any fumes from the crankcase are filtered through the air inlet system. Therefore, by-products from oil and from combustion can collect in the turbocharger compressor housing. Over time, this buildup can contribute to loss of engine power, increased black smoke and overall loss of engine efficiency.

If the turbocharger fails during engine operation, damage to the turbocharger compressor wheel and/or to the engine may occur. Damage to the turbocharger compressor wheel can cause additional damage to the pistons, the valves, and the cylinder head.

NOTICE

Turbocharger bearing failures can cause large quantities of oil to enter the air inlet and exhaust systems. Loss of engine lubricant can result in serious engine damage.

Minor leakage of a turbocharger housing under extended low idle operation should not cause problems as long as a turbocharger bearing failure has not occurred.

When a turbocharger bearing failure is accompanied by a significant engine performance loss (exhaust smoke or engine rpm up at no load), do not continue engine operation until the turbocharger is repaired or replaced.

An inspection of the turbocharger can minimize unscheduled downtime. An inspection of the turbocharger can also reduce the chance for potential damage to other engine parts.

Note: Turbocharger components require precision clearances. The turbocharger cartridge must be balanced due to high rpm. Severe Service Applications can accelerate component wear. Severe Service Applications require more frequent inspections of the cartridge.

Removal and Installation

For options regarding the removal, installation, repair and replacement, consult your Caterpillar dealer. Refer to the Service Manual for this engine for the procedure and specifications.

Cleaning and Inspecting

1. Remove the exhaust outlet piping and remove the air inlet piping from the turbocharger. Visually inspect the piping for the presence of oil.

2. Turn the compressor wheel and the turbine wheel by hand. The assembly should turn freely. Inspect the compressor wheel and the turbine wheel for contact with the turbocharger housing. There should not be any visible signs of contact between the turbine wheel or compressor wheel and the turbocharger housing. If there is any indication of contact between the rotating turbine wheel or the compressor wheel and the turbocharger housing, the turbocharger must be reconditioned.

3. Check the compressor wheel for cleanliness. If only the blade side of the wheel is dirty, dirt and/or moisture is passing through the air filtering system. If oil is found only on the back side of the wheel, there is a possibility of a failed turbocharger oil seal.

   The presence of oil may be the result of extended engine operation at low idle. The presence of oil may also be the result of a restriction of the line for the inlet air (plugged air filters), which causes the turbocharger to slobber.

4. Use a dial indicator to check the end clearance on the shaft. If the measured end play is greater than the Service Manual specifications, the turbocharger should be repaired or replaced. An end play measurement that is less than the minimum Service Manual specifications could indicate carbon buildup on the turbine wheel. The turbocharger should be disassembled for cleaning and for inspection if the measured end play is less than the minimum Service Manual specifications.

5. Inspect the bore of the turbine housing for corrosion.

6. Clean the turbocharger housing with standard shop solvents and a soft bristle brush.

7. Fasten the air inlet piping and the exhaust outlet piping to the turbocharger housing.

i00632301

Walk-Around Inspection

SMCS Code: 1000-040

Inspect the Engine for Leaks and for Loose Connections

A walk-around inspection should only take a few minutes. When the time is taken to perform these checks, costly repairs and accidents can be avoided.

For maximum engine service life, make a thorough inspection of the engine compartment before starting the engine. Look for items such as oil leaks or coolant leaks, loose bolts, worn belts, loose connections and trash buildup. Make repairs, as needed:

- The guards must be in the proper place. Repair damaged guards or replace missing guards.
- Wipe all caps and plugs before the engine is serviced in order to reduce the chance of system contamination.

NOTICE

For any type of leak (coolant, lube, or fuel) clean up the fluid. If leaking is observed, find the source and correct the leak. If leaking is suspected, check the fluid levels more often than recommended until the leak is found or fixed, or until the suspicion of a leak is proved to be unwarranted.

NOTICE

Accumulated grease and/or oil on an engine or deck is a fire hazard. Remove this debris with steam cleaning or high pressure water.

- Ensure that cooling lines are properly clamped and tight. Check for leaks. Check the condition of all pipes.
- Inspect the water pump for coolant leaks.

Note: The water pump seal is lubricated by coolant in the cooling system. It is normal for a small amount of leakage to occur as the engine cools down and the parts contract.

Excessive coolant leakage may indicate the need to replace the water pump seal. For the removal of water pump and the installation of water pump and/or seals, refer to the Service Manual for the engine or consult your Caterpillar dealer.

- Inspect the lubrication system for leaks at the front crankshaft seal, the rear crankshaft seal, the oil pan, the oil filters and the valve cover.
- Inspect the fuel system for leaks. Look for loose fuel line clamps.
- Inspect the piping for the air inlet system and the elbows for cracks and for loose clamps.
- Inspect the alternator belt and the accessory drive belts for cracks, breaks or other damage.

Belts for multiple groove pulleys must be replaced as matched sets. If only one belt is replaced, the belt will carry more load than the belts that are not replaced. The older belts are stretched. The additional load on the new belt could cause the belt to break.

- Drain the water and the sediment from fuel tanks on a daily basis in order to ensure that only clean fuel enters the fuel system.

- Inspect the wiring and the wiring harnesses for loose connections and for worn wires or frayed wires.
- Inspect the ground strap for a good connection and for good condition.
- Inspect the engine-to-frame ground strap for a good connection and for good condition.
- Disconnect any battery chargers that are not protected against the current drain of the starting motor. Check the condition and the electrolyte level of the batteries, unless the engine is equipped with a maintenance free battery.
- Check the condition of the gauges. Replace any gauges which are cracked or can not be calibrated.

i01057943

Water Pump - Inspect

SMCS Code: 1361-040; 1361

A failed water pump might cause severe engine overheating problems that could result in the following conditions:

- Cracks in the cylinder head
- A piston seizure
- Other potential damage to the engine

Visually inspect the water pump for leaks. If any leaking is observed, replace the water pump seal or the water pump assembly. Refer to the Service Manual for the disassembly and assembly procedure.

Note: Refer to the Service Manual or consult your Caterpillar dealer if any repair is needed or any replacement is needed.